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THE BOTANICAL GAZETTE

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In the April number will appear:

Some fungi common to wild and cultivated plants, by DR. BYRON D. HALSTED, of *Rutgers College, New Brunswick, N. J.*

A simple self-registering auxanometer, by GEORGE E. STONE.

Suggestions on the classification of the Metaphyta, by PROF. CONWAY MACMILLAN of the *University of Minnesota, Minneapolis.*

The identity of Asclepias stenophylla and Acerates auriculata, by MR. JOHN M. HOLZINGER, *Assistant Botanist of the Department of Agriculture, Washington, D. C.*

BOTANICAL GAZETTE

MARCH, 1892.

Flowers and insects. VII.

CHARLES ROBERTSON.

MARTYNIA PROBOSCIDEA Glox.—I know of but one station for this plant—on the banks of the Macoupin Creek, where it appears to be indigenous.

The pale bluish corolla measures about 5½ cm. in length, its tube about 3½ cm. The tube within is finely spotted with bluish; on the lower wall there are about three orange lines leading from the narrow part of the tube and expanding in a large spot on the lower lip. The throat above is spotted with reddish, on the sides with bluish. The middle lobe of the lower lip is streaked with bluish and is straight, while the others are reflexed.

The anthers lie against the upper wall in the median line, with their cells directed longitudinally. The stigma is in advance of them and closes when touched, as observed by Delpino.[1] The narrow part of the tube is about 8 mm. long which with other characters of the flower seems to indicate an adaptation to long-tongued bees. I have found the flowers in bloom from Aug. 19 to Sept. 14. Sept. 3, 1890, I saw *Bombus americanorum* F. ♂ sucking the honey, its thorax being streaked with pollen.

At Metropolis, Ill., Aug. 14, Mr. C. A. Hart found it visited by *Xenoglossa brevicornis* Rab. (MS.) ♂ ♀.

DIANTHERA AMERICANA L.—The plant is rather common in shallow water of streams, the stems rising from 3 to 9 dm. and bearing small clusters of purplish flowers.

The flowers are proterandrous. The two-lobed upper lip stands erect and is strongly marked with purple. The lower lip is formed by three widely divergent lobes, which are white, the middle one with much purple.

[1] Sugli apparecchi delle fecondazione nelle piante antocarpee, 1867.

A straight stamen stands on each side. The anther cells are widely separated; one stands vertically, facing the corresponding cell of the other stamen; the other, the outer one, is placed horizontally and has its dehiscent surface turned upwards. The stamens stand so erect that at first I wondered how the bee would come in contact with them. I also wondered why the anther cells are at right angles to each other. As a rule, only two flowers are in bloom in the umbel-like cluster at a time. The three lobes of the lower lip, which we have observed are strongly divergent, are curved upward, so that it is most convenient for the bee to enter between the middle and one of the lateral lobes. In this way it is apt to brush the vertical face of the inner anther-cell. To reach the other flower, the bee crawls directly upwards and approaches it from above. In crawling up out of one flower and down into the other the bee is likely to touch the horizontal faces of the outer anther-cells.

The corolla tube is about 5 mm. long, so that the nectar can be obtained by tongues of medium length. The flower is evidently adapted to bees, but is often visited by flies and butterflies. I have found it in bloom from June 23 to Aug. 24. On July 5 and 9 I observed the following visitors:—

Hymenoptera—*Apidae:* (1) Apis mellifica L. ☿, s., ab.; (2) Bombus virginicus Oliv. ☿, s.; (3) Melissodes palustris Rob. ♂, s., ab.; (4) M. bimaculata Lep. ♂♀, s., ab.; (5) Ceratina dupla Say ♀, s.; (6) Epeolus lunatus Say ♂♀, s.; *Andrenidae:* (7) Agapostemon nigricornis F. ♀, s.; (8) A. radiatus Say ♂♀, s.; (9) Augochlora pura Say ♀, s. and c. p., ab.; (10) Halictus lerouxii Lep. ♂♀, s., ab.; (11) H. ligatus Say ♂♀, s.; (12) H. fasciatus Nyl. ♂♀, s.; (13) H. pilosus Sm. ♀, c. p.; (14) H. confusus Sm. ♀, c. p., ab.

Diptera—*Syrphidae:* (15) Allograpta obliqua Say, f. p.; (16) Mesograpta marginata Say, f. p.; (17) Sphærophoria cylindrica Say, f. p.; (18) Eristalis tenax L., s. and f. p.; (19) Helophilus laetus Lw., f. p.; (20) Tropidia quadrata Say, s., freq.; (21) Syritta pipiens L., f. p.

Lepidoptera — *Rhopalocera:* (22) Pieris rapae L.; (23) Phyciodes nycteis D.-H.; (24) Lycaena pseudargiolus B.-L.; (25) Pamphila metacomet Harr.; (26) Pholisora catullus F.—all s.

VERBENA STRICTA Vent.—The plant is quite common. The stem rises from 5 to 10 dm. and bears numerous erect spikes of blue flowers.

The corolla tube rises directly upward, bending outward above and joining the vertically expanded border, which is five-lobed and somewhat two-lipped, expanding from 6 to 12 mm. The tube is about 5 mm. long, is quite narrow and is closed at the mouth by a dense circle of hairs.

The flowers appear homogamous and I see nothing to prevent an insect's proboscis from carrying pollen from the anther back to the stigma of the same flower, though if the proboscis is thoroughly dusted with pollen from another flower, cross-pollination may be more likely.

I have found the flowers in bloom from June 15 to Sept. 16. On nine days, July 9—Aug. 7, I observed the following insects sucking the nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿; (2) Bombus virginicus Oliv. ♂; (3) Melissodes aurigenia Cr. ♂; (4) M. perplexa Cr. ♂♀, ab.; (5) Ceratina dupla Say ♀; (6) Epeolus mercatus F. ♂; *Sphecidae*: (7) Ammophila procera Klug.

Lepidoptera—*Rhopalocera*: (8) Pieris protodice B.-L.; (9) P. rapae L.; (10) Danais archippus F.; (11) Pamphila peckius Kby.; (12) P. cernes B.-L.; (13) Pholisora catullus F.; (14) P. hayhurstii Edw.; (15) Eudamus tityrus F.

Diptera—*Bombylidae*: (16) Exoprosopa fasciata Mcq. ab.; *Conopidae*: (17) Stylogaster neglecta Will.; *Syrphidae*: (18) Eristalis tenax L.

VERBENA HASTATA L.—This plant is less abundant than the last, grows taller and bears small spikes and smaller blue flowers.

The border is 3 to 5 mm. across and the tube 3 or 4 mm. in length.

I have found it in bloom from July 12 to Sep. 23. On 8 days, July 12—Sept. 7, the following insects were observed visiting the flowers for nectar:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, ab.; (2) Bombus americanorum F. ♂; (3) B. separatus Cr. ☿; (4) Epeolus remigatus F.; *Andrenidae*: (5) Agapostemon radiatus Say ♂; (6) Augochlora pura Say ♂, ab.; (7) Halictus lerouxii Lep. ♂♀; (8) H. fasciatus Nyl. ♂, ab.; (9) H. zephyrus Sm. ♂; *Sphecidae*: (10) Ammophila pictipennis Walsh.

Lepidoptera—*Rhopalocera*: (11) Pieris protodice B.-L.; (12) Pholisora catullus F.; (13) Eudamus tityrus F.

Diptera — *Bombylidae*: (14) Systoechus vulgaris Lw.; (15) Exoprosopa fasciata Mcq., ab.

VERBENA URTICAEFOLIA L. — The flowers are white, much smaller than in the preceding, and are arranged in long loose spikes. Blooms from June 29 to Sept 7, or later. On 8 days July 11—Aug. 29, I observed the following insects, all sucking:—

Hymenoptera — *Apidae*: (1) Apis mellifica L. ☿; (2) Bombus americanorum F. ♂☿; *Andrenidae*: (3) Augochlora pura Say ♂; (4) Halictus ligatus Say ♀; (5) H. confusus Sm. ♀.

Diptera — *Empidae*: (6) Empis clausa Rob. (MS.); *Conopidae*: (7) Stylogaster neglecta Will.; *Syrphidae*: (8) Mesograpta geminata Say; (9) Sphaerophoria cylindrica Say; (10) Syritta pipiens L.

Lepidoptera — *Rhopalocera*: (11) Pieris protodice B.-L.; (12) P. rapae L.

PHRYMA LEPTOSTACHYA L. — The plant grows in damp woods and is not very common. I have found it in bloom from July 10 to Sept. 3. The stem rises about 6 dm. high and bears several branches terminating in slender spikes, which commonly show but two flowers open at a time.

The flower and its three-lobed lower lip project horizontally, the short, slightly notched upper lip diverging in an upward direction. The corolla is white, tinged with pinkish, the upper lip being almost entirely pink. It measures 8 mm. in length, its tube 5 mm., the lower lip 4 mm. in width. The lower wall of the corolla is strongly infolded forming a sort of palate which presents on each side a ridge provided with numerous stiff hairs. This structure narrows the entrance so as to exclude short tongues and to require long tongues to touch the anthers and stigma. Small bees can force their heads into the tubes by forcing down the palate. The flowers are strongly proterandrous, and are visited by *Augochlora pura* Say ♂.

PHYTOLACCA DECANDRA L. — The stems of this common plant rise 2 m. or more, are much branched and bear numerous racemes of small whitish flowers. The five ovate, white sepals are incurved but expand so that the flower measures about 5 mm. across.

The flowers are proterandrous with a homogamous stage. Cross-fertilization between flowers of the same or of distinct plants may occur, and even self-pollination may occur by in-

sect aid. In absence of insects spontaneous self-fertilization may readily take place.[1]

The nectar is exposed. The flowers are visited by short-tongued Hymenoptera and Diptera, especially species of Halictus. I have found the plant in bloom from June 14 to Oct. 15. On July 17 and 23 I observed the following visitors:—

Hymenoptera — *Apidae*: (1) Apis mellifica L. ☿, s.; *Andrenidae*: (2) Halictus ligatus Say ♂, s.; (3) H. fasciatus Nyl. ♂, s.; (4) H. confusus Sm. ♀, s. and c. p., ab.; (5) H. zephyrus Sm. ♀, s.; (6) H. stultus Cr. ♂♀, s. and c. p., ab.; *Vespidae*: (7) Polistes metricus Say, s.; *Pompilidae*: (8) Priocnemis fulvicornis Cr., s.

Diptera — *Empidae*: (9) Empis clausa Rob. (MS.) s.; *Syrphidae*: (10) Mesograpta geminata Say, s.; (11) Syritta pipiens L., s., ab.; *Tachinidae*: (12) Jurinia apicifera Wlk. s.

HYPOXIS ERECTA L.—This plant is quite common in prairies and woods. The scapes, generally one to each plant, rise one or two dm., usually exposing only one open flower at a time. The flowers are yellow, the lanceolate divisions expanding horizontally from 12 to 25 mm. The six stamens are strongly divergent, the stigma occupying the centre of the circle, so that in absence of insects self-pollination cannot occur, unless it happens after the flowers close.

As a rule, insect visits result in cross-fertilization between distinct plants, but may also result in self-pollination.

The flowers are visited only for pollen, and depend especially upon Halictus. I have found them in bloom from April 28 to June 12. May 19 and 22 I observed as visitors:—

Hymenoptera — *Apidae*: (1) Ceratina dupla Say ♀, ab.; *Andrenidae*: (2) Augochlora pura Say ♀, ab.; (3) Halictus pectoralis Sm. ♀; (4) H. coriaceus Sm. ♀; (5) H. ligatus Say ♀; (6) H. cressonii Rob. ♀; (7) H. stultus Cr. ♀; (8) H. tegularis Rob. ♀; (9) H. anomalus Rob. ♀ — all collecting pollen.

Diptera — *Syrphidae*: (10) Mesograpta geminata Say; (11) Sphaerophoria cylindrica Say; *Anthomyidae*: (12) Chortophila sp.

Coleoptera — *Buprestidae*: (13) Acmaeodera culta Web. — all feeding on pollen.

ERYTHRONIUM ALBIDUM Nutt.—This is one of the first flowers of spring, and is quite common. The flower bud ap-

[1] According to Meehan, Proc. Acad. Nat. Sci. Phil. 1890, 272, the flower is spontaneously self-fertilized before opening.

pears with a pair of leaves and rises on a scape only a few centimetres above the ground. Owing to a bend in the scape, the flower looks outward and downward, or directly downward. The divisions of the perianth are white, tinged with purplish exteriorly, and marked with yellow at the base within, especially the three petals, which hold nectar on the bases of their claws. At base the divisions are closely approximated, forming a tube about 15 mm. in length, and making the nectar hard to reach except by insects with long tongues; beyond they are directed outward and downward, or may be expanded horizontally so that the flower measures 65 mm. across, or they may be so strongly reflexed that their tips meet, as in the case of plants growing in rich bottom soil.

The anthers of the three outer, shorter stamens dehisce first. At this time, if an insect come with pollen, it will leave some upon the stigma, which is somewhat in advance of the dehiscent anthers; otherwise, it may effect self-pollination. Cross-fertilization may readily occur at any time, but when the inner anthers dehisce, they may easily leave some of their pollen upon the stigma, since they usually surpass the stigma a little. Accordingly, in absence of insects, I think that self-pollination commonly occurs.

The pendulous position of the flower has the effect of restricting the visitors almost exclusively to bees, since they can readily cling to the stamens and style. The first flowers, which appear before flower insects become common, are visited almost exclusively by hive-bees.

For the attention of insects the plant is in competition with Anemonella thalictroides, Isopyrum biternatum, Sanguinaria Canadensis, Viola palmata, Claytonia Virginica and Dentaria laciniata. Competition with Claytonia is most severe; I have found it difficult to collect the visitors of Erythronium until afternoon, after the flowers of the Claytonia had closed.

I have found the plant in bloom from Mar. 17 to Apr. 22. On 13 days, between Apr. 7 and 19, I saw the flowers visited by:—

Hymenoptera—*Apidae*: (1) Apis mellifica L. ☿, s. and c. p., ab.; (2) Bombus virginicus Oliv. ♀, s., one; (3) Ceratina dupla Say ♂, s.; (4) Osmia atriventris Cr. ♂, s., ab.; (5) O. albiventris Cr. ♂♀, s., ab.; (6) O. lignaria Say ♂, s.; (7) O. latitarsis Cr. ♂, s.; (8) Nomada luteola Lep. ♂, s., ab.; *Andrenidae*: (9) Andrena bicolor F. ♂♀, s., ab.; (10) A. sayi Rob. ♂, s.; (11) A.

erythronii Rob. ♂♀, s. and c. p., ab.; (12) A. mariae Rob. ♀, s.; (13) Halictus lerouxii Lep. ♀, s.; (14) H. fasciatus Nyl. ♀, s.; (15) H. confusus Sm. ♀, s.; (16) Colletes inaequalis Say ♂, s. ab.

Lepidoptera—*Rhopalocera*: (17) Pieris rapae L., s.; (18) Colias philodice Godt., s.; (19) Nisoniades juvenalis F., s.

Diptera—*Bombylidae*: (20) Bombylius fratellus Wd., s., one; *Syrphidae*: (21) Brachypalpus frontosus Lw., f. p., one; *Muscidae*: (22) Lucilia cornicina F., s., not touching stigma.

TRADESCANTIA VIRGINICA L. (smooth form).—The plant is smooth and glaucous with linear leaves, the stems rising 3 to 6 dm. and bearing from one to three umbel-like clusters of flowers, each umbel in turn with from 1 to 5 open flowers. The flowers are blue, expanding 3 or 4 cm., but retaining a shallow, bell-shaped form. The stigma is widely separated from the anthers and somewhat surpasses them. Spontaneous self-pollination is hardly probable while the flower is open. Cross-pollination between flowers of the same plant may occur, but owing to the small number of flowers exposed on one plant at a time, cross-pollination between flowers of distinct plants is much more probable.

The flowers are specially adapted to female bees, and other insects in search of pollen. The hairs on the stamens are foot-holds for the use of bees in collecting pollen.

The plant is in strong competition with Rosa humilis for the attention of pollen-visitors, Tradescantia having the advantage of abundance and Rosa of conspicuousness. But they avoid competition to some extent by dividing the visitors between them, Rosa taking the large ones and Tradescantia the small ones.

I have found it in bloom from May 22 to July 30. The following list of visitors was observed on June 4, 5 and 12:—

Hymenoptera—*Apidae*: (1) Bombus pennsylvanicus DeG. ♀; (2) Bombus separatus Cr. ♀; (3) Synhalonia speciosa Cr. ♀; (4) Ceratina dupla Say ♀; *Andrenidae*: (5) Agapostemon nigricornis F. ♀; (6) Halictus pruinosus Rob. ♀—all c. p.

Diptera—*Syrphidae:* (7) Syrphus ribesii L.; (8) S. americanus Wd.; (9) Allograpta obliqua Say; (10) Mesograpta marginata Say; (11) Sphaerophoria cylindrica Say; (12) Tropidia mamillata Lw.

Coleoptera—*Curculionidae*: (13) Stethobaris sp.—all f. p.

Carlinville, Ill.

Evolution in methods of pollination.

ALICE CARTER.

[*Concluded from p. 46.*]

Among animals, the phase of natural selection known as sexual selection comes to the front in the production of many things which we call beautiful or curious, such as the gorgeous colors of male birds and butterflies, the horns of beetles and reindeer, the tusks of boars and elephants, the chirping of crickets and the songs of birds. (It is noteworthy, here as elsewhere, how similar organs have been independently developed for similar ends in most widely different classes of organisms.) The higher plants, however, because of their fixed position, are removed from the power and influence of sexual selection, and its offices of the production of attractive qualities are performed for them in a most remarkable way by the agency of insects. Insect selection takes the place of natural selection, and to it we largely owe the fragrance, color and form of our beautiful flowers.[1] This is one side of the picture; the animals themselves are the other. Side by side with the flowers they frequent they have themselves been changed, their proboscides lengthening with the flower tubes, their bodies becoming better adapted to the forms of the blossoms and to the carrying of the pollen, their wits sharpened to find the means of getting at the hidden honey with the least possible loss of time and strength, and to read quickly the posters hung out by the plants, which enable the more intelligent customers to distinguish one kind of flower from another, and show them when the time for visiting is reached or passed. So now, instead of the primeval cockroach-like creatures, there are insects as varied and wonderful in form and structure as the flowers they frequent.

This subject is full of interest, and since the time of Darwin has been widely studied, but the knowledge accumulated should be put into form convenient for every day use. If, as we believe, flowers have been produced by a gradual adapta-

[1] The variations — the presuppositions of progress — are, of course, inherent in the plant nature, produced by causes not yet fully understood. The insects have simply chosen and therefore perpetuated those best adapted to their own needs which must also of necessity be those which are advantageous or at least not injurious, to the plants themselves.

tion to the reciprocal wants of plants and their visitors, from fructifications essentially like the spore-bearing spikes of the heterosporous Equisetums of which geologists write, this ought to be known by every student, and everyone should be able to see from the manual that, in each order, the method of fertilization is to a certain extent an index of the degree of specialization of the reproductive apparatus, the most important part of the plant. In many orders there is a most beautiful transition from anemophilous (usually polygamous, monœcious or diœcious) species through almost exclusively self-fertilized hemaphrodite ones to those that are incapable of self-fertilization. For example, in the Ranunculaceae, in the gradation from the wind-blown inflorescences of polygamous Thalictrums to the inconspicuous, almost exclusively self-fertilized flowers of Myosurus minimus; from this to the genus Ranunculus (whose small-flowered species, such as R. abortivus and R. sceleratus closely resemble Myosurus in the arrangement of the carpels and stamens, while the large species, R. repens, R. bulbosus, etc., are abundantly visited and crossed); from Ranunculus to Aquilegia, and from Aquilegia to Delphinium and Aconitum, there is a suggestion in the compass of a single order of the probable historical development of irregular, brightly colored, greatly specialized, insect-fertilized forms from the grass-like or pine-like, spore-bearing stalks of the ancestors of our dicotyledons.

At a certain stage of development, these changing plants will be perfectly adapted to neither wind nor insect fertilization; then those individuals whose stamens and pistils are borne in adjacent clusters, or better yet, within the same bracts, will be most sure of ripening seed. Clavaud says: "There does not exist a diœcious plant which cannot exceptionally offer the two sexes upon the same stalk." The common occurrence of stamens in the pistillate, and of pistils in the staminate clusters of trees and other plants described as monœcious or diœcious, is known to every observer. Such variations, sometimes perhaps preserving the lives of the plants which possess them, will be passed on to their descendants. In other words, hermaphrodite flowers may have arisen from unisexual ones, as unisexual ones are now actually being produced from hermaphrodite (e. g. in many genera of Labiatæ, in some species of Silene). So it comes to pass that though the majority of wind-fertilized plants have the sexes

separated, almost all entomophilous ones have stamens and pistils in the same flowers. Müller therefore considers diclinism to have been the original condition of phanerogams, from which hermaphroditism has been developed by natural selection. Darwin takes exactly the opposite view. But it hardly seems necessary to adopt either exclusively, for both hermaphrodite and unisexual forms are common among the lower plants. Why cannot both forms have been transmitted from the pteridophyte-like ancestors of phanerogams? Diclinism and bisexualism may be collateral branches, one not necessarily older than the other, though in many individual cases it is evident that one has been, or is being derived from the other.

When a plant has become adapted either to self or insect fertilization there is no longer necessity for the production of vastly greater quantities of pollen than can be used, for either method is more sure than dependence upon wind agency. Frugal nature then turns the energy no longer needed for spore formation into another channel. Some of the stamens, losing their power to produce pollen, may become exclusively organs of attraction. Numerous transition stages are represented in the genera Thalictrum, Clematis, Nymphaea, etc. The origin of brighter color may be like that of nectar (BOTANICAL GAZETTE, vol. XV, p. 177) a result of the unusually active life processes in connection with the strong current necessary to supply the ovules and anthers with materials required for the development of their richly fed spores. The same principle is at work which Wallace and others have shown to prevail among animals, whose highly colored organs are, as a rule, those which are most continually exercised; e. g. the wings of butterflies, the wings, tails and beaks of birds, etc.

Again, the rule that among animals a great number of similar segments is a mark of low organization, seems to hold good here. Contrast the numerous stamens and pistils and the variable number of petals or sepals of water lilies, buttercups and anemones with the small and always constant number characteristic of the aristocratic families, the Violaceæ, Compositæ, Labiatæ and Scrophulariaceæ. This decrease in the number of the floral organs is often accompanied by further specialization by the union of their individual members to secure still better protection of the pollen, honey and ovules and better adaptation to the agents of pollination.

When cross-fertilization by means of insects has become assured, the color, time of flowering, fragrance, the length of the corolla tube, the form and position of the petals and sepals, all have reference to time of flight and character of the especially invited guests. Every hair has a meaning. Every curve is an adaptation. The power of self-fertilization, at first indispensable, may become useless. A struggle for existence arises between the two methods and the least efficient goes to the ground. So cross-fertilization is, as a rule, alone possible among the majority of orchids, some Compositæ, some species of Salvia, Aconitum, Corydalis, Dianthus, Malva and others. Many changes, progressive and retrogressive, are still going on. It is known that the honey of more than one hundred and thirty-two flowers can be plundered from outside without the touching of the stamens or stigma. In these cases at least, perfection has, not been reached; but the wonderful contrivances to prevent the entrance of useless guests, such as hairs on the calyx, corolla or stamens, slipperiness of the corolla, a pendent position of its tube, or the accumulation in the petals of matters offensive to insects, show that some species are on the high-road to it.

So much for flowers; but there are weeds, hundreds of them, widespread and homely. Many, perhaps all, of those which have the rudiments of calyx and corolla are degraded forms, descendents of species once fertilized by insects, but which, because of the extinction of the particular ones on which they either depend, or because they have spread into regions where these insects are not, or because thrown into the shade by the superior attractions of their neighbors, have been obliged to resort again to wind agency (Plantago?), or to adapt themselves to almost exclusive self-fertilization (Veronica hederæfolia). In either case there is no longer need of attractive organs and the petals have accordingly been reduced. The evil effects of continued self-fertilization may have had a share in this result; but probably not to a great extent, for such effects will be largely counteracted by the wide dissemination so characteristic of weeds, by which these low forms are exposes to great variation of climatic conditions. The loss is then of beauty, not of strength. Change of environment seems often to have as beneficial results as cross-fertilization in the stimulation of the life processes and the production of varieties. The degradation here, as elsewhere, is only a peculiar form of adaptation.

The theory that, by whatever means gained (by the crossing of individuals if possible, if not by self-pollination), the great object of plant-life is the production of seed, the continuance of its species, receives further support by the presence in many of the forms, most beautifully adapted to the visits of insects, of cleistogamic flowers. These are minute, never-opening flowers whose stamens produce very little pollen (from 100 to 400 grains in contrast to the 243,600 of Leontodon or the 3,654,000 of Peony), but the anthers are in close contact with the stigma, none of the pollen is wasted and the inevitable self-fertilization causes the ripening of seed enough to secure the the existence of the species, if for any reason the more conspicuous flowers are not visited. Kuhn enumerates 44 genera which have flowers of this kind; Darwin adds 12 (Viola, Impatiens, Lespedeza, Specularia, Campanula Lathyrus, etc.) May it be this small form which alone survives in some degraded species?

Such study has led me to many delightful hours spent in watching the visits of insects to flowers, with, for one result, great respect for Darwin's famous aphorism, "nature abhors perpetual self-fertilization." For though I waited a long time often, sometimes for days together, to "win the secret of some weed's plain heart," the flower lover was almost sure to come at last in the form of buzzing bombuses for the two species of Monotropa, a tiny fly for the little shore pin weed (Lechea thymifolia), clumsy bugs for the honeyless, dull-colored purple trillium (Trillium erectum), pollen eating bees and flies for the homely ragweed (Ambrosia artemisiæfolia.) During the last spring, summer, and autumn I caught a thousand insects on one hundred and forty-three species of plants (one of a kind on each). One hundred and thirty-one of these flowers are visited by Hymenoptera, fifty-seven by Lepidoptera, sixty-two by Diptera, seven by the ruby-throated humming bird. I shall not soon forget the first sight of a humming bird draining dry the nectar cups of the columbine (Aquilegia Canadensis); nor the daily visits which he afterwards made to the trumpet honeysuckle, trumpet creeper, fraxinella, Petunia, Lunaria, Rhododendron, or Rhodora; nor the silent watching in the evening for the ghost-like, dusky-winged humming bird moth, whose capture is as memorable as that of a boy's first six-pound salmon; nor the dark evening when a valiant sweep of the net over the

Japanese honeysuckle captured a supposed humming bird moth which proved to be only a June bug. The beautiful clear-winged moth (Sesia), whose first visit to the Azalea of the botanic garden was so sudden and brief that after long waiting vainly for his return I almost concluded that he had been the delusion of an excited imagination, afterwards proved himself a capturable reality and we enjoyed the further acquaintance with his family through their visits to Lunaria, Hydrophyllum, Dictamnus, Syringa, and Vinca. The memory of the gorgeous red butterfly which twice visited the smooth sumach (Rhus glabra L.), eluding our nets both times never again to appear notwithstanding our patient waiting and the reward offered for his arrest, will haunt me through the winter months and until the shade of one of his descendants joins the full ranks of those who met death on the sumach field.

Botany and zoölogy at the start are one, but when the debatable ground occupied by organisms neither animal nor vegetable is passed, each has a clear country until paths cross again in this region of reciprocal plant and animal selection. If the descent theory is true, a natural system of classification which shall show true relationship is, to some extent, possible. Such a classification has been largely adopted for the lower plants, and it will come for all. Then the standard manual of botany will no longer separate what nature has joined together; the gymnosperms will not stand between the sister classes of angiosperms, nor gamopetalous between the polypetalous and apetalous exogens. The relationship which all acknowledge will be clearly shown. The arrangement of species in each order will be a story in brief of the development of the order itself, the means of fertilization being an important factor of the determination of the comparative degree of specialization of each species. Then too we shall do away with the undignified jump from phanerogams to cryptogams, using instead the natural ladder which has been stretched between them, the gymnosperms, whose life history is in some respects so like that of pteridophytes, in others so like that of close-ovaried plants that it is hard, impossible indeed, to say to which they are most closely related. Our classification will follow the teachings of geology, histology, embryology, and common sense, and, standing on the vantage ground of a manual founded on the brotherhood

of plants, we can look over the broad battlefield of biology, and see the vast territories which have been conquered, then relinquished in turn by mosses and fungi, pteridophytes, cone-bearing plants, endogens, apetalous and polypetalous exogens, and now are largely held by today's victors, the gamopetalous dicotyledons. We can see how the hardy pines have fought stubbornly for centuries, yielding ground only inch by inch to the endogens, the secret of whose final victory was that, Niobe-like, they protected their children though perishing themselves. We can see too how these children have been driven to the marshes, windswept plains, and cold mountain hills by the onslaughts of their more completely armed younger brothers, who, leagued with the great insect kingdom, are carrying all before them.

That will be a view well worth looking at and the sooner we begin the climb to the high ground, the better. The botany of the past is a most vital part of the botany of today. Zoölogy must join hands with us. We are dependent on each other. Distribution, genealogy, and environment will enter largely into the manuals of the future. Then the touch of nature which makes the whole world kin will be added to the long Latin names and mechanical descriptions.

[The foregoing paper was prepared at Mt. Holyoke Seminary and College, S. Hadley, Mass.]

Ithaca, N. Y.

F. W. Anderson, Sc. D.

F. D. KELSEY.

(WITH PORTRAIT.)

This rising young botanist died in New York city on Dec. 22, 1891 from an abcess on the brain. He was especially known as an independent and indefatigable worker upon our Montana flora. Gone is he, no more to roam with me our Montana plains, no more to climb these mountains, no more to sit beside me in my study gazing through my microscope to discover Nature's secrets, no more to use his skilful pencil in catching upon paper the singular beauties of plant structure; gone while we are mutually planning for many more years of service together in our beloved science; gone, adding one more to the mysteries of divine providence which so often removes those that seem nidispensable.

F. W. ANDERSON.

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He was born at Wisbech, Eng., June 22, 1866. In 1881 the family removed to Chicago and in 1883 he came to Montana and began his brief but brilliant career in the study of the Montana flora. In 1888 he met at Great Falls, Montana, Hon. N. J. Colman, then United States Commissioner of Agriculture. At the same time also he met the then editor of the *American Agriculturist*, the Hon. Mr. Martin, who became so attached to him that the love became as a father for a son. From this time, Mr. Anderson's life was spent in Washington, at Newfield, N. J., with Mr. J. B. Ellis, or at New York at work upon the *Agriculturist*. He was beginning to publish botanical articles quite largely and venture upon revisions and description of new species.

Mr. Anderson was an example of what can be accomplished by a man of one idea. From earliest childhood he manifested a liking for scientific pursuits. For the love of botany he surrendered in later years all thought of ease, wealth or comfort. It was heaven for him to botanize; woe was it for him to be forced to do anything else.

His honored father who survives him is a clergyman, and, like all clergymen, knows what a perplexing problem it often is to make the unknown "*x*" in the yearly equation a plus quantity. Of course, his son Fred was too much of a man to allow himself to be a burden upon the struggling father. Hence he often endured poverty rather than give up his botanical investigations.

His energy was intense, and in the freedom of my intimate relationship with him I dubbed him my "night owl"; many a time forcing him to rest long before he himself would have surrendered to sleep.

The College of Montana at Deer Lodge in June, 1890, conferred upon him the degree of Doctor of Science, in acknowledgement of his valuable services in investigating the flora of our state. This was an honor of which he knew nothing until it was thrust upon him.

The agricultural department at Washington, through Mr. Galloway and Mr. Martin, put him at one time to active service at Washington where he remained until he entered the service of Mr. J. B. Ellis, the distinguished mycologist, of whom Mr. Anderson published a biographical sketch in the GAZETTE for October, 1890. He was engaged while at Newfield in making the microscopical drawings for Mr. Ellis for

his forthcoming work on the "North American Pyrenomycetes." Upon completing his work for Mr. Ellis he was engaged upon the editorial force of the *American Agriculturist* at New York. Upon taking up his permanent residence at New York, he was elected to membership in the Torrey Botanical Club whose meetings were to him a constant delight. At this time he published, jointly with myself, a pamphlet entitled: "Common and Conspicuous Algae of Montana." This was a reprint from the Bulletin of the Torrey Botanical Club.

He began his botanical publications by sending to the BOTANICAL GAZETTE short field notes and observations from Montana, and later published observations upon our Montana fungi. His articles have most of them been short and crisp, giving promise of far greater effort in the near future. He was especially skillful in drawing and was at the time of his death engaged upon drawings for Mrs. E. G. Britton's proposed work on the mosses of the northeastern United States. In Dr. Geo. Vasey's "Report of the botanist" for 1888 is incorporated a very valuable essay of fourteen octavo pages on the pastoral resources of Montana by Mr. Anderson. It does not pretend to be a complete list of forage plants in Montana, but it does describe well the usual and profitable forage of this country. He had a remarkable talent for making such a list very interesting reading even for the unprofessional. In the same report can be seen three of his drawings, viz: Plantago Patagonica, var. gnaphalioides; Lygodesmia juncea; and Solanum triflorum.

Mr. Anderson is also a valuable example of what a poor boy, without special scientific education, without instruction in a university, with a delicate and treacherous constitution, with poverty always dogging his steps, can do in a short but earnest youth.

Two things he loved with great enthusiasm, good books and botanical novelties. For the books I have seen him spend every cent he possessed; for the other no mountain was too steep, no distance too great, no weariness too distressing for him to endure, that he might lay his hands upon a new flower or grasp a new fungus. He seemed to know by instinct where to find a treasure. The inspiration of his botanical knowledge was intensified by the fact that he gained his knowledge at first hand. He knew whereof he spoke or wrote. Moreover he was a close observer of nature and a diligent collector.

His friendships were keen and constant; slow to form an affection, but once formed they were warm and enduring. He sought his friendships among the good, the diligent and the lovers of nature. By us who knew him best his loss is most keenly felt, and the botanical world is the loser not only of the talent he had exhibited, but, prospectively, of the greater things which his short career promised.

Helena, Montana.

Enumeration of the Kansas mosses.

F. RENAULD AND J. CARDOT.

Kansas, and chiefly the central part of this state, is certainly one of the regions the most destitute of mosses of any part of the United States: the atmospheric dryness, a climate extensively variable and liable to extremes of temperature and the extension of cultivated and meadow lands are the causes of the poverty of this bryological flora. For a long time it was a common belief that this land was almost entirely destitute of mosses; but it has been proved by recent researches that such is not the case, and if the moss-flora of this country is very poor in comparison with that of other states it includes, however, a relatively important number of species. The most part of these, however, grow in meagre, stunted and sterile specimens, which often makes their determination very difficult.

In 1884-85-86 Mr. Eugene A. Rau published in the *Bulletin of the Washburn College Laboratory of Natural History* four contributions to the knowledge of Kansas mosses, including a total of fifty-three species, collected chiefly by Prof. F. W. Cragin, Miss Mara Becker and Mr. Joseph Henry. The last, who died on October 12, 1887, aged more than 74 years, sent us during the year 1885 and until his death, all the species he had collected in Saline county, and by the study of this collection we are able to add nearly forty species to those previously reported by Mr. Rau.

The present catalogue includes all the mosses recorded in the four lists published by this bryologist and all those that we received from Mr. Jos. Henry. Several of these re-

main doubtful, and some specimens, too incomplete to allow any determination, have been omitted.

All the species of which we have received specimens are indicated by the affirmative mark (!); the asterisk (*) indicates those which are not recorded in Mr. Rau's contributions. The geographical names are those of counties unless otherwise noted.

*Sphagnum molle SULLIV.—Saline, a very young sterile form (*Henry*)!
*Micromitrium sp?—Too young for determination. Saline (*Henry*)!
Ephemerum spinulosum BS.— Saline (*Henry*)!
* papillosum AUST.—Saline (*Henry*)!
Phascum cuspidatum SCHREB. (?)—Saline, sterile (*Henry*)!
* var. piliferum BS.—Saline (*Henry*)!
*Microbryum Floerkeanum SCH. var. Henrici REN. & CARD. Bot. Gaz. XIV. 91. (1889). Saline (*Henry*)!
*Pleuridium Bolanderi C. MUELL.(?)—Saline, sterile (*Henry*)!
*Archidium Hallii AUST.—Saline (*Henry*)!
*Astomum crispum HPE.—Saline (*Henry*)!
* Sullivantii SCH.—Saline (*Henry*)!
Weisia viridula BRID.—City of Topeka (*Field*). Shawnee (*Becker*, *Cragin*). Wyandotte (*Bennett*). Saline, common (*Henry*)!
var. stenocarpa C. MUELL.—Verdigris valley, Wilson (*Cragin*).
Dicranella varia SCH.—City of Topeka (*Cragin*). Shawnee (*Becker*). Saline, common (*Henry*)!
heteromalla SCH.—Saline (*Henry*)! Also a sterile form, with shorter leaves; rather doubtful. Saline (*Henry*)!
Dicranum scoparium HEDW.—Labette (*Nelson*). Saline, sterile form with leaves often broken at point (*Henry*)!
*Campylopus Henrici REN. & CARD. Bot. Gaz. XIII (1888), 197 pl. XIV.—Saline, sterile (*Henry*)!
Fissidens bryoides HEDW.—Saline (*Henry*)!
* Bambergeri SCH.—Saline, sterile (*Henry*)! New to North America.
* obtusifolius WILS.—Saline, sterile (*Henry*)!
* var. Kansanus REN. & CARD. Bot. Gaz. XV (1890), 40.—Saline (*Henry*)!
osmundoides HEDW.—Brown (*Becker*).
Ceratodon purpureus BRID.—City of Topeka (*Field*). Ford (*Cragin*). Saline, a sterile form (*Henry*)!
*Pharomitrium subsessile SCH.—Saline (*Henry*)! with the young form named by Austin *P. exiguum*.
*Didymodon species nova?—Saline (*Henry*)!
Leptotrichum pallidum HPE.—Saline, sterile form with leaves often broken at point (*Henry*)! Labette, a doubtful sterile form (*Newlon*).
vaginans SCH.—Saline (*Henry*).
*Trichostomum crispulum BRUCH.—Saline, common; several sterile forms (*Henry*)!
*Desmatodon arenacens S. & L.—Saline, sterile (*Henry*)!
* plinthobius S. & L. (?).—Saline, sterile (*Henry*)!—Owing to the absence of fructification, it is almost impossible to decide whether these specimens belong to *Desmatodon plinthobius*, or to *Barbula muralis* Timm.
Barbula Henrici RAU, Bull. of the Washb. Coll. Lab. 1 (1886), 172.—Saline, sterile (*Henry*)! We suspect this plant, known only in sterile state, to be referable to *Pharomitrium subsessile*.
unguiculata HEDW.—City of Topeka, Wilson (*Cragin*). Brown (*Becker*). Saline, common and very variable, but generally sterile (*Henry*)!

fallax HEDW.—Saline ,sterile (*Henry*)!
* convoluta HEDW.—Saline, sterile (*Henry*)!
caespitosa SCHW.—Wabaunsee (*Baldwin*). Saline (*Henry*).
Grimmia apocarpa HEDW.—Saline sterile (*Henry*)!
calyptrata HOOK.—Saline (*Henry*).
* leucophæa GREV.—Saline, common, but sterile (*Henry*)!
* Olneyi SULLIV. (?).—Saline, a sterile stunted form (*Henry*)!
*Hedwigia ciliata EHRH.—Saline, a sterile and very stunted form, with leaves not piliferous (*Henry*)!
*Coscinodon Wrightii SULLIV.—Saline (*Henry*)!
* Renauldi CARD. Bot. Gaz. XV (1890), 41, pl. VI, B.—Saline (*Henry*)!
Orthotrichum strangulatum BEAUV.—Saline (*Henry*)!
Pyramidula tetragona BRID.—Saline (*Henry*).
Physcomitrium pyriforme BRID.—City of Topeka (*Fields, Cragin*). Brown (*Becker*). Labette (*Newlon*).
acuminatum BS —Long Island, Phillipps county (*Hatcher.*)
* turbinatum C. MUELL.(?)—Saline, sterile (*Henry*)!
Funaria hygrometrica HEDW.—City of Topeka (*Fields, Cragin*). Labette (*Newlon*). Saline (*Henry*)!
Bartramia pomiformis HEDW.—Labette (*Newlon.*)
* radicalis BEAUV.—Saline, sterile (*Henry*)!
*Philonotis Muehlenbergii BRID.—Saline, not uncommon but sterile (*Henry*)!
marchica BRID.—Saline (*Henry*). Reported by Rau, but perhaps referable to the last.
Webera annotina SCHW.—Shawnee (*Becker*).
albicans SCH.—Brown (*Becker*). Wilson (*Cragin*). Saline, sterile (*Henry*)!
Bryum argenteum L.—City of Topeka (*Fields*). Kansas River, Shawnee, Wilson (*Cragin.*) Saline sterile (*Henry*)!
* caespiticium L.—Saline, not uncommon, but sterile (*Henry!*)
bimum SCHREB.—City of Topeka (*Cragin*), Saline (*Henry*).—Perhaps referable to the following.
* pseudotriquetrum SCHW.—Saline, common, but sterile (*Henry*)!
* Ontariense KINDB. Bull. of the Torr. Bot. Club, XVI (1889), 96.—Saline, a few sterile stems (*Henry*)!
Mnium cuspidatum HEDW.—City of Topeka, common (*Fields*). Shawnee (*Becker, Cragin*). Wabaunsee (*Baldwin*). Brown (*Becker*). Labette (*Newlon*). Wyandotte (Bennett). Saline, common (*Henry*)!
affine BLAND.—Shawnee (*Cragin*). Saline (*Henry*).
* var. elatum BS.—Saline, sterile (*Henry*)!
Atrichum undulatum BEAUV.—Saline (*Henry*), reported by Rau, but probably referable to the following variety.
* var. altecristatum REN. & CARD. Bot. Gaz. XV (1890). 58.—Saline (*Henry*)!
angustatum BS.—Town of Tecumseh (*Cragin*). Shawnee (*Becker, Cragin*). Labette (*Newlon*). Wyandotte (*Bennett*). Saline (*Henry*).
* xanthopelma LESQ. & JAMES.—Saline, not uncommon (*Henry*)!
* Fabronia octoblepharis SCHW.—Saline, sterile (*Henry*)!
Thelia asprella SULLIV.—North Topeka (city), and Shawnee (*Cragin*). Brown (*Becker*).
Leskea polycarpa EHRH.—Town of Wakefield, Clay (*Cragin*). Shawnee, Brown (*Becker*). Wyandotte (*Bennett*). Saline, common, several forms (*Henry*)!
Austini SULLIV.—Saline (*Henry*)!
Anomodon rostratus SCH.—Wabaunsee (*Baldwin*). Verdigris valley, Wilson (*Cragin.*) Saline, sterile (*Henry*)!
attenuatus HARTM.—Wyandotte (*Bennett.*)
obtusifolius BS.—City of Topeka (*Fields*). Brown (*Becker*). Saline (*Henry*)!

Pylaisia intricata BS.—Jefferson (*Cragin*). Saline (*Henry*)!
*Cylindrothecium cladorrhizans SCH.—Saline (*Henry*)! with a form much resembling *C. brevisetum* by its stems and branches less compressed, and its pedicel shorter.
seductrix SULLIV.—Shawnee (*Cragin, Becker*). Wabaunsee (*Baldwin*). Brown (*Becker*).
* compressum BS.—Saline (*Henry*)!
*Climacium dendroides WEB. & MOHR.—Saline sterile (*Henry*)!
*Thuidium recognitum LINDB. ? Th. delicatulum LINDB. ?—Saline, sterile (*Henry*)!
Brachythecium lætum BS.—Shawnee (*Becker*). Wabaunsee (*Baldwin*). Labette (*Newlon*). Saline, sterile (*Henry*)!
* var. dentatum LESQ & JAMES.—Saline, sterile (*Henry*)!
acuminatum (BEAUV).—City of Topeka (*Fields*). Shawnee, Brown (*Becker*). Wilson (*Cragin*). Saline, common, but sterile (*Henry*)!
rivulare BS. (?).—Saline (*Henry*). Wyandotte (*Bennett*).
plumosum BS. (?).—City of Topeka (*Fields*). Saline, doubtful (*Henry*.)
Eurhynchium strigosum BS.—Wabaunsee (*Baldwin*).
* praelongum BS.—Saline, sterile (*Henry*)!—Lesquereux and James, in the "Manual of the Mosses of North America," p. 353, state that "the true *Hypnum praelongum* has scarcely been found on this continent," where its place is supplied by the *H. hians* Hedw. However, all the specimens we have hitherto seen from North America are found quite identical with the European forms of *H. praelongum*, their leaves being serrulate all around, a character which does not agree with description of *H. hians*.
hians (HEDW.)—Shawnee (*Becker, Cragin*).

Rhynchostegium serrulatum (HEDW.)—City of Topeka (*Fields*) Wabaunsee (*Baldwin*). Jefferson (*Cragin*) Saline, sterile (*Henry*)!
Plagiothecium sylvaticum BS.—Saline (*Henry*).
Amblystegium serpens BS.—City of Topeka, Tecumseh (*Fields, Cragin*). Shawnee (*Becker, Cragin*). Brown (*Becker*). Jefferson (*Cragin*) Saline (*Henry*)!
* varium (BEAUV.)—Saline, common (*Henry*)!
* porphyrrhizum SCH.—Saline, (*Henry*)! Seems to be identical with *A. hygrophilum* Sch.
* adnatum (HEDW.).—Saline, sterile (*Henry*)!
riparium BS.—Brown (*Becker*). Saline (*Henry*)!
var. cariosum SULLIV.—Saline (*Henry*).
* var. serratum REN. & CARD. Bot. Gaz. XIV (1889), 98.—Saline (*Henry*)!
* Kochii SCH.—Saline (*Henry*)! New to North America.
Hypnum hispidulum BRID.—Shawnee (*Cragin*). Brown (*Becker*). Saline (*Henry*)!
chrysophyllum BRID.—Labette (*Newlon*). Saline, sterile (*Henry*)!
aduncum HEDW.—Saline, sterile (*Henry*)!

Surveying the whole of this bryological florula it becomes immediately evident that the most part of the species are characteristic for the flora of the middle and eastern states. As such are chiefly to be noted: Sphagnum molle, Micromitrium ?, Ephemerum spinulosum, E. papillosum, Astomum Sullivantii, Fissidens obtusifolius, Pharomitrium subsessile, Leptotrichum vaginans, Desmatodon arenaceus, Grimmia Olneyi ?, Orthotrichum

strangulatum, Philonotis Muehlenbergii, Bryum Ontariense, Fabronia octoblepharis, Thelia asprella, Leskea Austini, Anomodon rostratus, A. attenuatus A. obtusifolius, Pylaisia intricata, Cylindrothecium cladorrhizans, C. seductrix, C. compressum, Brachythecium laetum, B. acuminatum, Rhynchostegium serrulatum, Amblystegium varium, A. adnatum, Hypnum hispidulum, H. chrysophyllum.

The following species belong to the flora of the southern states (Texas Louisiana, etc.) and reach here their extreme limit northward: Archidium Hallii, Desmatodon plinthobius ?, Barbula caespitosa, Physcomitrium turbinatum ?, Bartramia radicalis, Atrichum xanthopelma.

Grimmia calyptrata and Coscinodon Wrightii seem more especially peculiar to the flora of the Rocky Mountains. Trichostomum crispulum and Pleuridium Bolanderi ? were hitherto only recorded from California.

Monaco, and *Stenay, France.*

Noteworthy anatomical and physiological researches.

Ovular structure of Casuarina suberosa.[1]

In this work of Treub's we have a very good example of the sensational in plant morphology. The word is not at all to be taken in a bad sense but fitly describes the altogether unsuspected results which have followed this careful investigator's examination of a group of plants of acknowledged difficulty. After discussing the insertion of the ovules and their curious displacements which have caused much discussion (see on this Baillon, Eichler, Miquel and Engler), Treub takes up the ovular structure with the following conclusions:

1. Certain large sub-epidermal cells in the young ovule are an archesporium and develop the macrospores (embryo-sacs). They lie at the summit of the nucellus and undergo a series of tangential segmentations, finally producing a thick cylinder of sporogenous tissue which, surrounded by the tapetal layer, occupies a central position in the nucellus.

2. The cells of the sporogenous layer develop tetrads of spores, of which three become absorbed, in some cases, but in

[1] Treub: Sur les Casuarinèes et leur place dans le system natural. Ann. Jard. Buitenz. x. 145–231.

others may be seen to form tracheids which are thus analogous to the elater cells of Hepaticæ The latter condition is the one observed in *Casuarina glauca* and *C. Rumphiana*.

3. Twenty macrospores are found and these elongate in the plane of the greater axis of the nucellus.

4. The micropylar ends of the macrospores develop two or three small cells which are to be considered as homologous with the canal-cells of the Eu-archegoniata and not as synergidæ. Generally only one of the macrospores has these cells endowed with a cellulose wall and this cell is the future embryo-sac.

5. The pollen tube divides, after reaching a nucellus, into at least two branches—thus reminding one of the well known phenomena in Taxus, Juniperus and Salisburia where one pollen tube is employed for the fertilization of several egg-organs.

6. A large number of endosperm nuclei are formed before the embryo is developed, thus indicating again the similarity of these cytogenetic sequences to those of the Gymnospermæ (Archispermæ).

7. Casuarina is therefore believed to occupy a decidedly anomalous position among the Metaspermæ (Angiospermæ). It is nearer to the Archispermæ than any form yet examined and may be given a place apart from the rest of the higher seed-plants. Treub proposes the following classification to admit Casuarina to its proper place, as indicated by his researches:

Archispermæ. . . . .

Metaspermæ { Chalazagameæ :: Casuarina.
Porogameæ :: { Dicotyledoneæ.
Monocotyledoneæ.

Casuarina, the only genus of its family, contains about 30 species. They are of limited range, being found principally in Australasia. A very good account of them may be found in Grisebach's *Vegetation der Erde*, and in Engler's *Natürliche Pflanzenfamilien* there is a fair figure showing their remarkable habit of growth—so similiar to that of Equisetum that they were originally classed with that genus. They are characteristic plants in the Australian forests and with their vegetative and distributional features taken into account, it is not inherently improbable that the singularly isolated position as-

cribed to them by Treub is a correct one. Their future examination is likely to be productive of much interest.—CONWAY MACMILLAN.

A contribution to the knowledge of nuclear mechanics in the sexual and other reproductive cells of plants.[2]

The paper of Guignard here noted is remarkable not only for the brilliant series of researches which it chronicles but also for the able review of a mass of literature which is not yet very well known to any except a small coterie of specialists. Reference is made to the memoirs on the subject of the intimate phenomena which are now known to go on in both plant and animal cells in process of division, and have been called the spermatokinetic and ookinetic processes. Guignard gives a résumé of the important conclusions which have been reached in both the plant and animal world and adds some luminous suggestions concerning the physical basis of heredity. A number of the facts brought forward in this paper are not altogether new, having before appeared in recent works of the same author, but the generalizations and many of the illustrative examples are not hitherto published. Guignard has been studying the development of pollen and embryo-sacs—particularly in *Lilium martagon*—and has followed out in great detail the complicated and yet altogether orderly nuclear phenomena which invariably accompany the act of reproduction and are part of its very essence. Without the aid of any very extraordinary technique or the necessity of unusually difficult manipulations he has contributed a number of extremely interesting observations along his line of work. Some of these may be briefly noted.

1. Just outside the nuclear membrane in all cells examined there are to be distinguished two small spheres of protoplasm —called by their discoverer "directive spheres." They are not easily stained by ordinary methods. These two spheres lie side by side in the resting nucleus but when the nucleus begins to divide they are seen to have a special position and function to perform. They separate and pass to opposite ends of the nucleus and form the astrocenters towards which the chromosomes slowly move and accomplish the division of

[2]Guignard: Nouv. études sur la fécondation, Ann. Sci. Nat. Botan., Ser. VII. XIV. pp. 163—288.

the colorable nuclear elements. While the division is in what is commonly called the "spindle" stage the astrocenters each divide and thus form at each end of the old nucleus a *pair* of directive spheres. With the development of the nuclear membranes in the two daughter-nuclei the spheres take up their normal positions and the process may be repeated as the divisions continue. It is this contribution to our knowledge of the morphology of the astrocenter that counted so much for Guignard in the assignment of the Prix Bordin, just awarded him by the French Academy.

2. In mother-cells of spores the nuclear plate consists of twenty-four chromosomes but in the spores themselves and in sexual cells the number is only twelve. The sexual act then consists in the *addition of a number of chromosomes, that brings the number up to the normal again.*

3. These chromosomes are purely passive and their union is a function of the directive spheres which accompany them just outside the nuclear membrane which encloses the chromosomes themselves. This is brought about as follows in L. martagon—the plant of particular study:

4. After the pollen tube has reached the egg-cell, which lies in the embryo-sac immediately behind the two synergidae, the male nucleus is seen to pass over to the egg-cell and take up a position beside it in such a way that the two directive spheres are in contact with each other. The two nuclei generally lie in the same horizontal plane but in rare cases one may lie above the other. The two spheres now slip out in pairs, one pair going to what will be one pole of the now almost mature segmentation nucleus and the other pair going to what will become the other pole. As the nuclear membranes, now in close contact, dissolve, the central portions of each pair of spheres (the centrosomes) become merged and a *single directive sphere lies at each pole of the segmentation nucleus*. These become the astrocenters for the segmentation nucleus. Since the male nucleus contains more easily stained chromatin than the female, Guignard was in many cases able to tell, by examination, which chromosomes in the segmentation nucleus had come from the male plant and which from the female. He found that after the absorption of the membranes lying between the two copulating nuclei and the formation of the plate in the segmentation nucleus the male

and female chromosomes were shifted about in such a way that some of both kinds were diverted to each pole.

5. The two most important theoretical considerations noted, are, first, that the nucleus can no longer be considered as taking the initiative in the work of cell-fusion but this must be given back to the protoplasm from which the directive spheres are formed. The nuclei are but passive parcels of hereditary substance transmitted from one cell to another and always under the dynamic control of the spheres. Second, the male and female sexual cells transmit the same number of chromosomes and thus indicate that they have an equivalent part in the heredity and that the view that the male is merely a stimulant or irritant under which the female nucleus takes on the character of a segmentation nucleus is not supported by the facts of morphology in the case in hand.

The article is given a fitting close by ten of those plates which are made nowhere but in Paris. In them one can follow with the greatest ease the investigations of the author and alone they constitute no mean addition to the literature of mitosis.—CONWAY MACMILLAN.

Burnt spots on leaves.[1]

It is a well known fact, that the green parts of plants, especially the leaves, may show local or partial decolorations, due to different factors. We do not speak of the decoloration which is generally referred to chlorosis or etiolation, but of the yellow, brown or perfectly black spots which are not uncommon upon the leaves of plants kept in greenhouses. Such spots may be due to parasitic animals or plants or to inorganic agents. In the last case they are characterized as "burnt spots." This disease has been recorded in literature long ago. Burnt spots have been attributed to several pathological changes, which, although they showed great similarity to those caused by a relatively high temperature, nevertheless originated from quite different factors.

One of the oldest theories to account for these, and as it seems the only acceptable one, was that which ascribed them to the common presence of air-bubbles in the glass used as cover for green-houses. The air-bubbles were supposed to have

[1] JÆNSSON BENGT: Om brænnflæckar paa væxtblad. Botaniska Notiser. Lund 1891. 30 pp. 2 colored plates.

the effect of lenses, by which the sunlight became concentrated and thereby caused a burning of the exposed parts of the leaves. Another theory, quite generally adopted, was that drops of water left on the leaves after they had been watered, might have the same effect as lenses or by their own heat be able to burn the leaves, especially in houses without sufficient ventilation.

De Candolle suggested that the burning might be caused by the drops of water, which at once softened the tissue of the leaves, became heated in the sunlight and thereby prevented evaporation. In *Gardener's Chronicle* for 1858 burnt spots on orchids were said to originate from too much moisture in connection with too low temperature.

The explanation most commonly adopted, however, is that which attributes the effect to drops of water having been heated by the sunlight and it has been so recorded in the more prominent phytopathological manuals. Sorauer for instance in his *Pflanzenkrankheiten* explains the fact quite briefly by this statement. Neumann[1] came to the same conclusion by some experiments he made with *Cordyline*. On the other hand he observed that if the leaves were fastened in a certain position they were burnt even if there was sufficient draught. Another author, who has almost adopted the same theory, is Frank[2], although he does not exclude the possibility that the drops of water might also be able to act as lenses. And he found support in Hoffmann who was the first to show, by experiments on grapes, that drops of water in a hanging position are able to concentrate the sunlight and to produce burning. Later von Thümen[4] expressed full accordance with Hoffmann. But the old theory, that the burnt spots were caused by air-bubbles in the glass, seems to have been entirely abandoned, although Neumann (l. c.) was not quite unaware of the possibility of its correctness; he did not believe, however, that such air-bubbles could burn except through very short distances.

The author of the present paper calls attention to the fact that the true burnt-spots are easily distinguished by their

[1] Adansonia, Vol. II, 1862, p. 312.

[2] Die Krankheiten der Pflanzen, 1880, p. 174.

[3] Samenbruch bei der Weinbeere, Botan. Zeitung 1872, p. 113.

[4] Ueber den Sonnenbrand der Rebenblætter, Die Weinlaube 1886, p. 409.

most frequently elliptical form with the longest diameter often from east to west, and if they occur several together on one leaf, they form always longitudinal rows from east to west, the spots in the middle being the largest. He has made a series of experiments so as to test the different theories, which have been enumerated above. It has been thereby proved, that drops of water are unable to cause any kind of burning by their own heat. Further, as shown by Sachs, the vegetative cell of land-plants is able to stand a heat of 51° C. All the experiments, made by the author in that direction, gave negative results, so that Neumann's theory cannot be correct. Some experiments were made with water of a temperature above 60° C., but even this did not affect the leaves.

As regards the supposition, that drops of water might have the same effect as lenses, it is quite clear that drops which have fallen on leaves merely represent half-lenses, a fact to which already De Candolle has called attention. And it is shown by experiments, that only when the drops of water were out of contact with the leaves, do they become able to cause a kind of burning, for instance when hanging down from the inside of a glass cover.

The author has come to the conclusion that in most cases the burnt spots are due to the poor quality of the covering glass, by the air bubbles of which the sunlight becomes concentrated so as to produce a burning on the leaves.—THEO. HOLM.

BRIEFER ARTICLES.

Cleistogamy in the genus Polygonum.—On page 273, vol. XVI, BOTANICAL GAZETTE, it is noted that "Mr. Thomas Meehan has found cleistogamous flowers in abundance on *Polygonum acre* and suspects the same habit in other species." On page 314 of the same volume of the GAZETTE, Mr. T. H. Kearney, Jr., records his observation of cleistogamous flowers upon *Polygonum acre* at Knoxville, Tenn., accompanying his note with figures. Mr. Kearney farther states that he has "searched for cleistogamic flowers on other species of Polygonum without success."

I am led by the appearance of these notes to state that in my studies of the genus Polygonum, I have found cleistogamous flowers

on many species, thus verifying the thought of Mr. Meehan. From an examination of my preliminary notes upon the genus, verified by a reëxamination of the specimens, I report the finding of cleistogamous flowers upon the following species: *P. arifolium*, in which the achenes in my specimens were incompletely developed; *P. Bolanderi*, *P. Californicum*, *P. Careyi*, *P. Hartwrightii*, *P. Hydropiper*, the condition being extremely common in this species; *P. hydropiperoides*, in which in every case examined the achenes were perfected; *P. lapathifolium*, *P. maritimum*, *P. ramossissimum*, in which case, however, I am not thoroughly convinced as to the cleistogamous character of the flowers so referred; *P. sagittatum*, and *P. Persicaria*. I found that in almost every case in which I had *late* collections of the species mentioned above, cleistogamous flowers existed. That more species are not included in the list is, I am inclined to believe, due to the fact that the specimens of the other forms in my possession were collected in the earlier portion of their season. I believe that in all cases where collections are made after Sept. 15th, cleistogamous flowers may be reasonably expected.

The figures given by Mr. Kearney in the note referred to above present an exceptional condition. In the many forms which I have examined it only occurs once or twice. Ordinarily the cleistogamous flowers are completely concealed by the sheath, but if well developed their presence may be detected by the appearance of an apparent intumescence of the sheath on one side of the stem and slightly above the node. Occasionally when the sheath is short the tip of the flower may be seen projecting a little beyond its border. In the ordinary herbarium specimen, unless care is taken in the dissection, the flower will be taken for a fragment of the sheath, unless indeed the achene be well developed. I have as yet detected only a single flower at each node, but am not prepared to say that this is the rule.

In this connection I would like to ask botanists throughout the country to send me any notes they may have upon the genus, and to state that I would be glad to receive specimens for examination from such as are willing to spare them for a sufficient time for their proper study.—STANLEY COULTER, *Purdue University, La Fayette, Ind.*

Cultivating the ascosporous form of yeast.—The methods usually recommended for securing the ascosporous state of yeast, i. e. by cultivation upon slices of potato or other vegetables, or even upon plaster of Paris slabs, have always ended in failure in my laboratory, until a recent trial by the method suggested by Hansen.[1] This method con-

[1] Les ascospores chez le genre Saccharomyces. Comp. rend. trav. du lab. de Carlsberg, ii, p. 30; also see Zopf, Die Pilze, p. 414.

sists essentially of securing particularly vigorous, actively growing yeast plants, which are transferred directly to moist slabs of plaster of Paris, on which they develop the spores very rapidly. The sudden change from the condition with abundance of nutriment to one with almost total absence of it, appears to call out the extreme reproductive safeguard of the species against annihilation.

Hansen advocates starting with pure cultures, from which some cells of yeast are transferred to beerwort for a short time at common room temperature, then a small quantity of the active cells is again removed to fresh beerwort for 24 hours at a temperature of 26–27° C. A supply of the cells thus obtained is sown upon sterilized blocks of plaster of Paris, which are made sufficiently moist to slightly glisten, and are afterward kept in a moist chamber at proper temperature.

The method followed in my laboratory was to add a little yeast, taken from a fresh cake of Fleischmann's compressed yeast, to a Pasteur solution. In a day or two, when the disengagement of gas showed that the yeast was in active growth, the liquid was poured out of the flask, some of the flocculent material adhering to the glass was spread upon the surface of a freshly made cake of plaster of Paris, which was barely moist, and the whole was covered to prevent drying out. The cakes were made by stirring water into powdered plaster of Paris and allowing it to harden in a shallow covered dish. In a few days a most abundant crop of ascospores was obtained. The spores are easily colored with methyl violet; and fine permanent mounts may be made by the coverglass method as used for bacteria.

The work was carried out by Messrs. Wright and Van Pelt of the present senior class.— J. C. Arthur, *Purdue University, La Fayette, Ind.*

EDITORIAL.

There is a wide field for American ingenuity in devising new adaptations of apparatus used in other departments, and in inventing new forms of apparatus, with which to illustrate the main truths of vegetable physiology. Much work of this kind must be done before the science can be so generally taught in high schools and colleges as its position as a fundamental science demands. Special forms of apparatus will naturally be brought out to meet the requirements of investigators working in original lines, which will enrich the available supply, but new methods of making old truths clear by means of

simple yet well constructed apparatus, are needed in all present laboratories. Not only do we need new kinds of apparatus, but it is also a matter of moment to know where both the old and new forms can be purchased at a reasonable price and without too great delay. At the present pedagogical stage of the science it is possible to buy only a few pieces that the books describe, and those must largely be imported at a cost that in some cases effectively excludes them from many laboratories. The annoyance of determining proportions, making drawings and carefully describing the required pieces in order to have them made to order, even for glassware, is too laborious and time-consuming to permit of doing much of it. At present many teachers are driven to making their own apparatus as best they can, which as a rule is not an economic expenditure of the teacher's time or of the institution's funds. Until the facilities for purchase, which now obtain for microscopical, physical, chemical and other kinds of apparatus, also embrace physiological pieces, laboratories will not multiply, and the science be taught with the completeness that its importance demands.

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BOTANISTS, particularly those of the upper Mississippi valley, have been watching with considerable interest the formation of the faculty of the new Chicago University. Hopes have been raised, as we noted the high scholarship and particularly the high degree of specialization of the men that were being appointed, that the chair of botany would be filled with some specialist of repute, and that thus the new institution would set the pace for some of the older ones that have shown themselves laggards.

BUT WE CONFESS that it was with a feeling of sore disappointment that we read in the Chicago papers of the appointment of a professor of "biology." Apparently it is to be the old story of zoölogy masquerading in borrowed plumage as biology, for the gentleman who has has been appointed is a well-known zoölogist. As to his qualifications on the botanical side we know nothing, but we do know that no one man can teach biology properly in such an institution as the Chicago University bids fair to be. It would be a difficult feat for one man to teach zoölogy alone or botany alone, as it should be taught; to ask him to teach both, savors too much of the time when a man could be "professor of natural science."

IT IS SINCERELY to be hoped that President Harper will see to it that he chair of biology is divided before zoölogy teaching comes to stand for biology in the institution from which we expect so much. If this

is not done we shall not be surprised to have an early announcement similar to that in the December number of the *American Naturalist*, in which appears the naive item — we are sure our readers will appreciate its fine humor — "Prof. C. H. Gilbert is professor of *Vertebrate Biology* in Leland Stanford University."

In this connection we are much pleased to note the establishment of a new chair of histology and cryptogamic botany at Cornell University. This is a move in the right direction.

CURRENT LITERATURE.

Kuntze's "Revisio Generum Plantarum." [1]

This is one of the most ambitious botanical works of recent years, and has involved a prodigious amount of labor. However botanists may differ as to its conclusions, they must always be grateful for the vast amount of facts thus brought together. It is becoming more and more apparent that the nomenclaturists are not to agree with each other, at least until another congress has definitely established a datum line. In the meantime the systematist who is not a nomenclaturist feels inclined to reserve his opinion until the dust has settled somewhat and things can be seen more clearly. When all the ancient records have been searched, and books like those before us have become numerously multiplied, and confusion worse confounded reigns, some one will begin to bring order out of chaos, stability out of upheavals. There is no desire here to criticize the efforts of nomenclaturists, of whom Dr. Kuntze seems to be the bright consummate flower, but to emphasize the fact that we are still in the period of "stirring up," not of "settling." Devoid of all principles, sound or otherwise, we hold ourselves in readiness to accept and use any name which gives promise of a reasonable tenure of life.

The Gazette has often given, and still maintains the opinion that the necessary changes in nomenclature should never be attempted in this wholesale fashion, but that they should be made by monographers, who have an abundance of material before them and know whereof they speak.

The volumes before us are such as will demand consultation by all those who deal in phytography. The wealth of reference is marvel-

[1] Kuntze, Otto.— Revisio Generum Plantarum vascularium omnium atque cellularium multarum secundum leges nomenclaturæ internationales cum enumeratione plantarum exoticarum in itinere mundi collectarum. 2 vols. 8 vo. pp. clxvix, 1011. Leipzig, London, Milan, Paris, New York (Gust. E. Stechert, 828 Broadway), 1891.

lous, while dates of genera and important works will furnish a mine of information to all systematists who do not have access to the extensive literature to be found at London and Berlin. The author seems to have caused most confusion by taking up the generic names of the first edition of Linnæus, Systema, instead of the first edition of his "Genera Plantarum." To illustrate, it may be imagined what confusion will arise in changing Nasturtium to Cardamine, Arabis to Erysimum, Lepidium to Nasturtium, and Sisymbrium to Hesperis. Upon the flimsiest pretext for example, Tragacantha replaces Astragalus, and its nearly 1500 species are renamed. To mention all the suggested changes, or even the startling ones, that have to do with North American plants would be impossible in the space at our command, but in this connection we are glad to call attention to the excellent service rendered by our friend, Dr. Britton, in printing in the February *Bulletin* the principal changes suggested for the generic names of North American plants, a service rendered still more valuable by his own annotations.

The plant world.[1]

Under this title Mr. Massee has published what appear to be lectures originally prepared for use under the auspices of the London Society for the extension of university teaching, to which society Mr. Massee is a lecturer. These lectures deal with plant architecture; the chemistry and physics of plant life; protective arrangements; reproduction in plants; relationship amongst plants; fossil plants; and the geographical distribution of plants.

Mr. Massee is a botanist of no mean repute, and one expects more of him than of an unknown tyro. The ground covered by this little book embraces some of the most interesting portions of the science. We wish that we could say that it is a readable book. It has very much in it to which no exceptions could be taken; much that is interesting and well put. But it is exceedingly uneven. In the main it is accurate, though not infrequently the writer's meaning is obscure because of his faulty English. This is the more remarkable by reason of the general clearness of Mr. Massee's scientific papers. On the side of fact the histological part of the chapter on plant architecture is perhaps the worst, and this also is marked by the poorest illustrations.

As a whole the style is very bad. The sentences are long and involved. Occasionally they extend to enormous lengths. We note one

[1] MASSEE, GEORGE :— The plant world, its past, present and future; an introduction to the study of botany. 12 mo., pp. x. 212, figs. 56. London: Whittaker & Co. (New York: Macillman & Co.) 1891. 3*sh.* 6*d.*

on pages 82 and 83 which is over a page long and contains 339 words, equalling about three-fourths of a page of the GAZETTE. Those covering half a page are frequent. These long sentences seem to be constructed on the same principle as the mnemonic word-chains; the thing with which the writer began reminded him of something, that of something else, and so on until by the time the period is reached one finds that he is talking of something rather remote from that with which he began. Here is a sentence which sadly needs mending: "It must be understood that potassium is not the only factor necessary for the formation of starch; but if this substance is absent, even if all other conditions are favorable, as in the case of iron and chlorophyll so also with starch which contains no potassium, the latter being necessary for promoting the chemical changes resulting in the formation of starch." p. 56.

We fear also that Mr. Massee's generalizations will be found much too sweeping. The voice is the voice of Massee, but the reasoning is the reasoning of Grant Allen. It is taking, but it is not sound.

Making a charitable guess we should say that Mr. Massee had been persuaded to allow his lectures to be printed without having or taking sufficient time to revise them properly. If these popular books were to be read only by specialists there would be little mischief in erroneous or faulty statements. But no book demands so much of an author as one that is prepared for readers who are not able to separate the wheat from the chaff. This book needs a little winnowing, and the grains of truth should be thoroughly brushed before they go through the mill of the "general reader."

Minor Notices.

THE VERY INTERESTING address of Dr. George L. Goodale as retiring president of the A. A. A. S. on the useful plants of the future, and some of the possibilities of economic botany, has been distributed in reprints from the *Proceedings* of the association.

THE MALTREATMENT of our shade trees and the diseases which are likely to follow the mechanical injuries which are inflicted upon them by thoughtless drivers, ignorant trimmers and ruthless linemen, formed the subject of an address before the Massachusetts Horticultural Society by Dr. W. G. Farlow, which has recently been reprinted from the *Proceedings* of the society. The society was urged to make an effort to secure legislation which should make compulsory the placing of guards around trees and the entrusting of the care of trees in public grounds only to persons specially trained for the purpose. The GAZETTE would bid such efforts God-speed.

In connection with the paper of the series on flowers and insects published in this number from the pen of Mr. Charles Robertson, it may be well to call the attention of all our readers who are interested in these topics, to the paper of the same series printed in the *Transactions* of the St. Louis Academy of Science, vol. v, p. 569. The orders therein treated are the Asclepiadaceæ to Scrophulariaceæ.

In a recent bulletin, notable as being no. 1 of the division of vegetable pathology, Dr. Erwin F. Smith adduces additional evidence of the communicability of peach yellows and peach rosette. The latter disease has been considered a form of the yellows, but Dr. Smith has recently described it as a different disease. It is spreading in the archean region of Georgia, and is more virulent than the yellows. Extermination of diseased trees is the only measure that can be suggested at present.

Mr. John Robinson published in the *Salem Gazette*, during the summer of 1891, a series of articles upon the trees of Salem and vicinity. These papers have since been revised, and now appear in pamphlet form issued by the Essex Institute. They were written for popular entertainment and instruction, but in Mr. Robinson's hands they have been made full of interest to botanists as well.

Dr. George Vasey's "Grasses of the Southwest," Part II, completing the first volume, has been distributed, and fully sustains the excellent character of Part I. Fifty species are illustrated by most excellent full page plates, and facing each plate is the descriptive text. We could have wished that with every description a full statement of the range of the species could have been given. The trimming of the leaves also has made binding difficult, for any further reduction will cut into the titles of plates or the figures themselves.

"The genus Polygala in North America," by Wm. E. Wheelock, is the title of the fourth and last number of Volume II of the "Memoirs of the Torrey Botanical Club." Mr. Wheelock has studied the specimens found in the largest American herbaria and Dr. Britton has examined most of the types preserved in Europe. The species number 38, and of these very full descriptions, synonymy, and range are given. A new species from Texas (*P. Tweedyi* Britton,) is described, and some new varieties proposed. *P. fastigiata* Nutt. (1818) is *P. Mariana* Mill. (1768); and *P. viridescens* L. replaces *P. sanguinea* L. of same date. The error of date under *P. Rugelii* had better be corrected. It should read Shuttleworth, Chapm. Botanical Gazette, iii. 4 (Jan. 1878).

Professor Greene's *Flora Franciscana*, Part II, continues that important work through 24 additional orders. The succession of families

is interesting to those only familiar with the ordinary sequence. The intercalation of Apetalæ among Polypetalæ has long been a much desired change, and it is a good thing to have it put in this concrete way and applied to our North American plants. The changes in generic and specific nomenclature are mostly such as Professor Greene has already indicated in previous papers.

OPEN LETTERS.

The new herbarium pest.

In reference to the article in the December number, 1891, by Prof. C. V. Riley on the "New Herbarium Pest," let me add my experience. Today in looking over duplicates four of the geometrid larvæ were found on Aphyllon Ludovicianum collected in this county in June, 1890. A few drops of a pretty strong solution of corrosive sublimate and arsenic in diluted alcohol were dropped on each. During an examination of the plants for more larvæ or eggs, in about twenty minutes, the liquid had evaporated, and the paper being again dry, I observed to my dismay the little surveyors stretch and move again, slowly at first, but in about five minutes as actively as before their bath. They are now bottled for observations. This extraordinary tenacity of life increases the formidability of this pest.— Dr. H. E. Hasse, *Santa Monica, Calif.*

NOTES AND NEWS.

The state of Kansas is spending $3500 in spreading the entomophthoral disease of chinch bugs under the direction of Professor F. H. Snow.

Professor W. C. Williamson, until recently at Owen's College, Manchester, has changed his residence to 43 Elms Road, Clapham Common, London.

Dr. Sereno Watson died March 9th, at his home in Cambridge, Mass., after a prolonged illness resulting from an attack of "la grippe." No tidings since the death of Dr. Gray will cause botanists profounder sorrow than this.

Dr. Thomas Taylor, the United States microscopist, is said to be preparing models of fungi for the Columbian Exposition, to include all the edible varieties of the United States.

The December number of the *Microscopical Bulletin* contains a very fine photogravure of Bacillus tuberculosis made from a photograph taken with Queen's 1-15 homogeneous immersion lens.

The university extension work of the State University of Iowa embraces twelve lectures on "world-making," four of which are devoted to plants. The botanical lectures are given by Professor T. H. McBride.

MRS. W. A. KELLERMAN has been writing very pleasantly about leaf variations, which she has observed from time to time. Several of her articles have appeared in *Science*, in the issues for Jan. 29, Feb. 12, and others.

THE HERBARIUM of the University of Minnesota contains about 42,000 plants, including 15,000 spermaphytes. It embraces sets of exsiccati by Ellis, Thümen, Sydow, Roumeguère, Krieger, Rehm, and some others, in the fungi.

TWENTY-THREE CALIFORNIAN WEED SEEDS are illustrated and described by Mr. Hubert P. Dyer in the annual report of the California Experiment Station for 1890, recently issued. The article is part of a graduating thesis.

A CERTIFIED list of exchanging botanists, classified according to their ability and usual practice in the preparation of herbarium specimens, is being compiled by Mr. J. A. Morton, secretary of the Canadian botanists' correspondence association.

THE SOURCE OF INFECTION for wheat rust is discussed by Professor H.L. Bolley in *Agricultural Science* for last December. He concludes that the uredospores are the chief generators of the rust, and that the wind may carry them very long distances, even hundreds of miles.

A REVISION of the North American species of Xyris, by Heinrich Ries, is published in the *Bulletin* of the Torrey Botanical Club (Feb.). Fourteen species are described (one new) and their range and synonymy given.

PROF. E. B. KNERR, of Midland College, Atchison, Kansas, will furnish fresh rooted specimens of *Erythronium mesochoreum* KNERR this spring to all who desire them, provided they send ten cents (to cover postage and packing) with their addresses. The plant usually begins to bloom shortly after April 1st.

MR. HAROLD WAGER of Leeds claims to have demonstrated the presence of a nuclear structure in a species of Bacillus which forms a thin scum on water containing Spirogyra in a state of decay. These researches combined with earlier ones leave little doubt of the presence of a nucleus at least in the more highly organized microbes.

SINCE THE appearance of Kuntze's *Revisio Generum Plantarum* Dr. John Briquet, who is elaborating the Labiatæ for Engler and Prantl's *Natürliche Pflanzenfamilien*, has examined the changes proposed by K. in the generic names of this order. Out of the fifteen suggested he considers five well founded.[1]

MR. R. E. FRY finds in certain cells of the stem of Euphorbia splendens aggregations of proteid which are "used as a reserve nitrogenous material, answering to starch among carbo-hydrates." Other species of Euphorbia and allied plants do not exhibit aggregations of such material.[2]

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[1] Bot. Centralb. xlix. 106.

[2] Annals of Botany v. 413.

THE OUTLINES of a university extension course of six lectures on the physiology of plants, which is being given at Tomah and Appleton, Wis., by Dr. Charles R. Barnes, have been distributed. The topics of the lectures are as follows: "How plants forage; How plants eat; How plants breathe; How plants grow; How plants move; How plants multiply."

PROFESSOR J. E. HUMPHREY has given in the *American Naturalist* (Dec.), under the title "The comparative morphology of the fungi," a very useful outline view of the conclusions contained in the last four parts of Brefeld's "Untersuchungen aus dem Gesammtgebiete der Mykologie;" views with which not merely every mycologist should be familiar, but every student of botany.

A LEARNED, interesting and suggestive lecture by Mr. Charles F. Cox of New York city, on the question, "What is a diatom?" is given in the January number of the *Journal of the New York Microscopical Society*. It not only answers the question from the technical and biological sides, but presents a strong plea for the toleration and encouragement of the study of pure science, based upon the history of the development of knowledge as influenced by the study of these organisms.

IN THE ANNUAL REPORT of the President of Harvard College, for 1890–91, it is stated that during the year the total number of specimens received by the Herbarium was about 13,000, and the number mounted and distributed 10,995. The total expenditure of the Herbarium was $6329.84, against $3048.60 in 1889–90, and $4493.23 in 1888–89. The additional expenditure of 1890–91 was made possible by the gift of $3500 a year for five years. This gift was made in the hope that it would ensure the completion of the Synoptical Flora.

IN BULLETIN 37 of the Cornell Experiment Station Professor Bailey gives a lucid account of the three species of Physalis which have come into cultivation as fruit-bearing plants, viz., P. pubescens, P. Peruviana and P. capsicifolia.— Prof. Bailey thinks that if some way can be found to make the pepino (Solanum muricatum), a very interesting plant of recent introduction, set fruit more freely in the north it promises to be an acquisition for the kitchen-garden and for market. — He recommends the chorogi (Stachys Sieboldi), the new tuberiferous labiate, for trial in every home garden.

SOME YEARS AGO Van Tieghem demonstrated the existence of invertase in pollen, a ferment which converts cane sugar into glucose. Experiments carried on by Mr. J. R. Green demonstrate the presence of diastase in the pollen of a number of common cultivated plants. Fresh pollen ground up between glass plates and mixed with a thin starch paste produced the usual disappearance of starch and formation of glucose. The ferment acts also when extracted by the glycerine method.[1]

PROFESSOR L. H. BAILEY in an admirable account[2] of the dewberries, shows that they arise from two species of Rubus, R. Canadensis and R. trivialis, of which the former also shows two well marked

[1] Annals of Botany v. 512.

[2] Cornell University Exper. Station, bulletin 34.

varieties, roribaccus and invisus. He calls attention again to the fact that the bush blackberry does not have any trailing forms, the so-called var. humifusus having apparently been established upon a dewberry. Apropos of this bulletin we may be permitted to remark that we know of no better model for experiment station botanists than the recent bulletins of the horticultural division of the experiment station of Cornell University.

AMONG THE BULLETINS of the experiment stations recently received are quite a number upon botanical topics. Dr. C. F. Millspaugh (W. Va., No. 19) writes on weeds, especially their value as fertilizers for the soil when suitably composted. Prof. L. H. Pammel (Iowa, No. 15) gives a very full account of the fungous diseases of the sugar beet, more particularly those caused by species of Uromyces, Cystopus, Cercospora and Rhizoctonia. Fungicides and their specific application are treated by Miss Freda Detmers and Mr. W. J. Green (Ohio, vol. IV, No. 9), Mr. E. G. Lodeman (Cornell, No. 35) and Mr. L. F. Kinney (R. I., No. 14).

THE FOLLOWING tribute is paid to Dr. Geo. L. Goodale in the last annual report of Harvard University: "The development of the botanical establishment of the University during the last ten years may fairly be called extraordinary. It has acquired a large fireproof museum, to contain not only its collections, but its lecture-rooms and laboratories; has added greatly to its collections and its library; and, at the same time, has obtained larger permanent funds for the support of the combined establishment. Every branch of the work has been developed and enriched. For all this material progress the University is chiefly indebted to Professor George L. Goodale, Director of the Botanic Garden."

TWO NUMBERS of the new *Forstlich-naturwissenschaftliche Zeitschrift* have reached us. In typography they are somewhat disappointing, since they are printed in German type instead of Roman, a step which the majority of scientific men will consider retrogressive, no matter to what nation they belong. The contents of the two numbers is as follows: Dr. Robert Hartig, The sickening and death of pines on account of defoliation by Liparis monacha; Dr. Carl von Tubeuf, The diseases of Liparis monacha; Dr. R. Weber, On the influence of seed production upon the ash constituents and nitrogenous reserve materials of the wood of the red beech; Dr. A. Pauly, On a breeding research with Pissodes notatus; W. Eichhoff, Suggestions as the extermination of insects injurious to forests and field-crops.

MR. SPENCER LEM. MOORE shows [1] that the callus with which sieve plates of the vegetable marrow are closed at the end of the growing season is formed of proteids. The slowness with which some of the proteid reactions take place have caused observers to deny their occurrence. The behavior of the callus with neutral salt solutions and other solvents is like that of coagulated proteids. They can be removed from the sieve-plates by a peptonizing fluid, and in nature their mode of removal strongly suggests the action of a proteolytic ferment, which however has not been isolated. Mr. Moore also finds that the so-

[1] Journal of the Linnean Society xxvii. 501.

called "stoppers" of the cells in the thallus of Ballia callitricha have similar reactions to the proteid tests, except that they do not dissolve under the action of a peptonizing ferment. He considers them of proteid nature, allied to lardacein.

At a recent meeting of the Linnean Society (Jan. 21), Mr. F. E. Weiss read a paper "On the development of the caoutchouc-containing cells of *Eucommia ulmoides*." He found that the bark and leaves of this tree, used medicinally by the Chinese, and called by them "Tu-chung," contain numerous elastic threads of silky appearance, which proved to be of the nature of caoutchouc. They are contained in long unbranching cells, somewhat like latex cells, which are found in the cortex and in the secondary phloem, and accompany in large numbers the ramifying bundles of the leaf and the pericarp. Unlike the ordinary latex cells, they are not derived from specialized cells of the embryo, but originate in all new growths, and can be seen forming in the cortex, the pith and the parenchyma surrounding the bundle of the petiole. They originate in twos, by longitudinal division of a very granular cell, both daughter cells growing out at their two extremities into a long tube, which makes its way along the intercellular spaces by sliding growth. They never contain more than one nucleus, and the large granules of caoutchouc, which soon make their appearance, finally coalesce into a single mass, which has, when the tissues are broken, the appearance of a silky thread. Mr. Weiss regards these cells as a primitive form of latex cells, similar to those from which the more elaborate ones of the ordinary Euphorbiaceæ may have been derived.—*Gard. Chron.*, Feb. 6.

A contribution to the detection and function of tannin is made by Moore in the seventh paper of his series: Studies in vegetable biology.[1] The summary is here reprinted:

1. Nessler's test for ammonia is a valuable aid to the botanist in detecting with certainty and rapidity the presence of tannin and tannic acids in plants. Other fluids having caustic potash for a basis are also good reagents for tannin. 2. Two chief kinds of tannin are to be distinguished according to their behavior with Nessler's fluid: (a) the iron-blueing tannin strikes brown with the fluid; (b) the iron-greening variety is turned yellow by it. 3. The yellow substance just mentioned readily diffuses through the cell wall; this effect is to be ascribed to the caustic potash, for alkaline solutions, even the weakest, will act in the same way. Here we have a provision, by the aid of rain, dew, and activity of soil organisms, for the excretion of tannin from the general surface of plants containing this form of it. 4. In addition to the functions hitherto ascribed to tannin, Haberlandt's recent discovery, with reference to the water-drop exuding on section of Mimosa pudica, renders it probable that tannic acid may have a more general relation to the turgescence of cells. Moreover, tannin is most likely used up in the lignification of the cell wall. 5. The diffusible tannin, although primarily excretory, and the non-diffusible kind when occurring in shed organs, may yet, in view of the fact that tannin can act as a source of carbon to fungi, have some indirect connection, *via* the nutrition of saprophytes, with the metabolism of green plants.

[1] Journal of the Linnean Society xxvii. 527.

THE HOMOLOGIES of the angiospermous embryo-sac and its contents always form an interesting subject for speculation. The prevalent view at present, that the embryo-sac is a macrospore and its contents a 7 or 8-celled prothallium, is not without objection; not a small one being that it in no way accounts for the conjugation of a micropylar and an antipodal nucleus to form what is known as the definitive nucleus. The formation of an 8-celled prothallium by nuclear division is perfectly clear; but the conjugation of two of these nucli is in no way explained by the ordinary view. Warming and Vesque consider that the eight nuclei produced within the embryo-sac represent two sets of four macrospores derived from two sporocytes, the embryo-sac thus becoming a special spore-mother-cell. Marshall Ward has advanced the view that the eight nuclei correspond to two 4-celled prothallia. Gustav Mann, however, in the Proc. Roy. Bot. Soc. of Edinburgh (June, 1891), who has been investigating the whole subject as exemplified by *Myosurus minimus*, has a hypothesis to suggest, which, so far as we know, is the first that has attempted to explain the double conjugation which takes place in the embryo-sac. He believes that the micropylar half of the embryo-sac corresponds to four female spores or macrospores; and the antipodal half to four male spores or microspores. Two of these eight cells conjugate, giving rise to the endosperm-cell, which must be looked upon as producing a true embryo, but which being weaker than the embryo resulting from cross-fertilization (of oosphere and pollen-nucleus), has become modified to serve as a storehouse for the stronger embryo. Such a theory would also play its part in suggesting explanations of apparent parthenogenesis and polyembryony. There is no doubt but that our views of the homologies of these parts must be modified; whether they will take the direction so ingeniously suggested by Mr. Mann is another matter.

Pringle's Plantæ Mexicanæ, 1891.

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